HBT correlations at RHIC and in-medium properties

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HBT correlations of bosonic particle pairs (pions, kaons, etc.) origin from the symmetrization of the two-particle wave function and provide important information on the space-time extension of the particle emitting source in heavy ion collisions. At RHIC, a first-order phase transition from a quark-gluon plasma to hadronic matter, associated with large hadronization times, was believed to lead to extraordinary large correlation radii. We have explicitly calculated the correlation functions with Pratt's correlation after burner. For the dynamical model we have coupled the early hydrodynamical description to the later microscopic description of the hadronic freeze-out. Resonances and their cross sections are taken into account explicitly and dominate the freeze-out dynamics in this hybrid-model approach (Fig. 1). Moreover, we studied in particular effects of modified in-medium resonance properties that may be present at typical freeze-out temperatures of roughly $\approx 100\,\mathrm{MeV}$. The calculated multidimensional pion correlation parameters are not unusually large (Fig. 2). Finite momentum resolution effects reduce the parameters (R_i and λ) as well as the ratio $R_{\mathrm{out}}/R_{\mathrm{side}}$. The calculated R_{side} agree with data while R_{out} and R_{l} are overestimated confirming the *HBT-puzzle*. A broadened in-medium ρ decreases in particular R_{l} improving the comparison to data and demonstrating the important role of medium modifications for the HBT analysis.

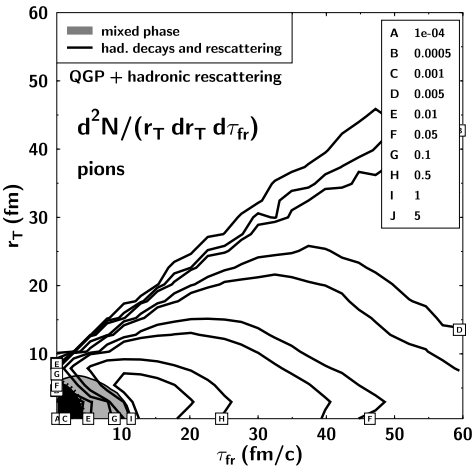

Figure 1: Freeze-out contours in transverse radius and time. The mixed phase is shown in grey.

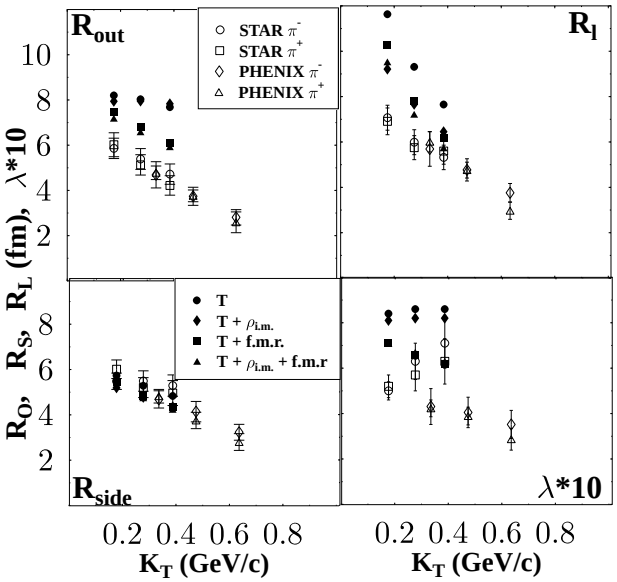

Figure 2: R_{out}, R_{side}, R_{l} and $\lambda \cdot 10$ for pions (Au+Au at RHIC). Full and open symbols are theory and experimental data, respectively. For theory (T), the effects of an in-medium ρ and finite momentum resolution (fmr) are investigated.

References

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[3] S. Soff, S. Bass, D. Hardtke, S. Panitkin, Phys. Rev. Lett. **88**, 072301 (2002).